

THERAPEUTIC EFFECTIVENESS OF HERBAL TOOTHPASTE FOR THE PREVENTION OF DENTAL CARRIES

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ABSTRACT:

Dental caries is one of the most common oral health problems worldwide and is primarily caused by microbial activity, poor oral hygiene, and dietary factors. The growing concern regarding the adverse effects associated with prolonged use of synthetic toothpaste has increased interest in herbal alternatives. The present study aimed to formulate and evaluate a herbal toothpaste containing clove (*Syzygium aromaticum*), amla (*Phyllanthus emblica*), neem (*Azadirachta indica*), and cinnamon (*Cinnamomum zeylanicum*) for the prevention of dental caries. The formulation was prepared using standard pharmaceutical methods and evaluated for various physicochemical parameters including appearance, smoothness, spreadability, foamability, pH, abrasiveness, and moisture content. The prepared herbal toothpaste exhibited satisfactory physical characteristics, good spreadability, acceptable foamability, and a slightly alkaline pH range of 8.03–8.07, which may help neutralize acids responsible for enamel demineralization. Abrasiveness testing confirmed the absence of harsh particles, indicating safety for tooth enamel, while moisture content remained within acceptable limits, suggesting good product stability. The therapeutic benefits of the formulation are attributed to the antibacterial, anti-inflammatory, antioxidant, and analgesic properties of the selected herbal ingredients. The study findings indicate that the herbal toothpaste is a safe, effective, and economical alternative to conventional toothpaste for maintaining oral hygiene and preventing dental caries. Further clinical investigations are recommended to validate its long-term efficacy and support large-scale commercialization.

KEYWORDS:

Herbal Toothpaste, Dental Caries Prevention, Oral Hygiene, Antibacterial Activity and Polyherbal Formulation

INTRODUCTION :

Oral hygiene is an essential aspect of overall health, and toothpaste plays a vital role in maintaining it (Lippert, 2013)[19]. Since ancient times, various natural substances have been used for cleaning teeth. Historical records indicate that early civilizations in India and China (300–500 BC) used materials such as crushed bones, eggshells, and herbal extracts for oral care (Divya & Suresh, 2021)[12]. With the advancement of science, modern toothpaste formulations began to include chemical components like fluoride, detergents, abrasives, and preservatives to enhance cleaning efficiency and prevent dental diseases (Lippert, 2013)[19].



Figure 01: Teeth structure

However, the continuous use of synthetic toothpaste has been associated with several side effects such as tooth sensitivity, enamel erosion, taste alteration, allergic reactions, and mucosal irritation (Addy & Dowell, 1983)[20] (Mason et al., 2019)[18]. These drawbacks have led to a growing

interest in herbal or natural alternatives that are safer, eco-friendly, and economical (Singh & Kaur, 2023)[6].

Herbal toothpaste formulations utilize plant-based ingredients known for their medicinal and therapeutic properties (Mehta & Joshi, 2024)[4]. Plants such as clove, neem, amla, and cinnamon have been traditionally used in oral care due to their antibacterial, anti-inflammatory, antioxidant, and analgesic properties (Grover & Shenoy, 2021)[13]. These herbal agents help in reducing plaque formation, preventing bacterial growth, and maintaining overall oral hygiene (Reddy & Kumar, 2024)[5].



Figure 02: Optimal oral hygiene

Dental caries is one of the most prevalent oral diseases worldwide (Verma & Gupta, 2024)[3]. It is a microbial disease caused primarily by bacteria such as *Streptococcus mutans*, which produce acids by fermenting carbohydrates (Kumar & Singh, 2025)[2]. These acids lead to the demineralization of tooth enamel, resulting in cavities, pain, and potential tooth loss (Sharma & Patel, 2025)[1]. Poor oral hygiene, improper diet, and lack of preventive measures contribute significantly to the development of dental caries (Devrimci & Sebnem, 2020)[14].

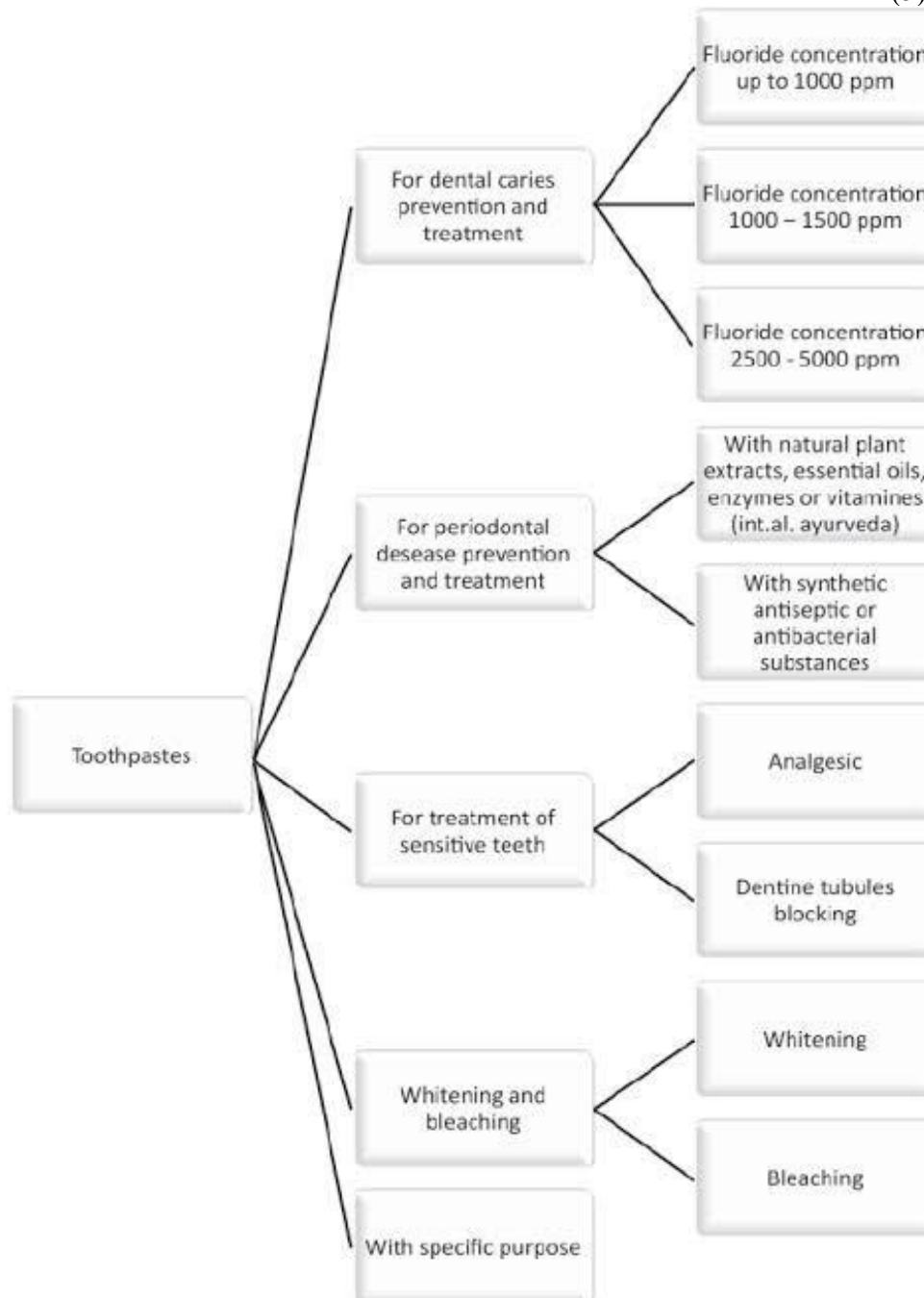


Figure 03: Classification of toothpastes based on fluoride concentration and therapeutic purpose

In this context, the present study aims to formulate and evaluate a herbal toothpaste containing clove, amla, neem, and cinnamon extracts. The objective is to assess its therapeutic effectiveness in preventing dental caries and compare its performance with conventional toothpaste formulations (Gangurde et al., 2023)[7] (Mali & Malik, 2022)[8].

RESEARCH METHODOLOGY:

The materials used in the formulation of herbal toothpaste are listed in Table 1. The selection of herbal ingredients was based on their documented medicinal properties (Senthilkumar et al., 2022)[9] (Rathi & Sirsat, 2022)[10].

Table 1: Table 1: Materials and Their Functions

S. No.	Ingredient	Botanical Name	Role/Function
1	Clove	<i>Syzygium aromaticum</i>	Antibacterial, analgesic (pain relief)
2	Amla	<i>Phyllanthus emblica</i>	Antioxidant, strengthens gums
3	Neem	<i>Azadirachta indica</i>	Antimicrobial, anti-inflammatory
4	Cinnamon	<i>Cinnamomum zeylanicum</i>	Antibacterial, flavoring agent
5	Calcium Carbonate	—	Abrasive (removes plaque)
6	Glycerin	—	Humectant (retains moisture)
7	Sodium Lauryl Sulfate (SLS)	—	Surfactant (foaming agent)
8	Sodium Chloride	—	Antiseptic and cleaning agent
9	Distilled Water	—	Solvent
10	Flavoring Agents	—	Improves taste and freshness

2.2 Method

The herbal toothpaste was prepared using standard pharmaceutical methods as described in previous studies (Palkar et al., 2020)[15] (Panda, 2019)[16].

2.2.1 Dry Gum Method

- All solid ingredients (calcium carbonate and herbal powders) were weighed and mixed thoroughly.
- Liquid components such as glycerin and distilled water were added gradually.

- Continuous mixing was carried out until a smooth and homogeneous paste was obtained.
- Surfactants (SLS) and flavoring agents were added at the final stage.
- The mixture was blended under controlled conditions to avoid air entrapment.

2.2.2 Wet Gum Method

- Liquid ingredients were first mixed to form a uniform base.
- Binding agents were added with constant stirring to form a mucilage.
- Solid ingredients were slowly incorporated into the mixture with continuous agitation.
- Surfactants and flavoring agents were added at the final stage.
- The final product was mixed thoroughly to obtain a smooth paste (Phalke et al., 2019)[17].

III EVALUATION PARAMETERS

The prepared herbal toothpaste was evaluated based on the following parameters, following standard protocols (Yadav et al., 2021)[11]:

3.1 Physical Examination

Parameter	Observation	Inference
Color	Brown	Acceptable
Odour	Characteristic	Pleasant
Taste	Saline	Acceptable
Smoothness	Smooth	Good texture
Appearance	Good	Overall satisfactory

Table 2: Table 2: Results of Physical Examination

3.2 Spreadability

Spreadability determines the ease with which the toothpaste can be applied (Gangurde et al., 2023)[7]. The test was performed by placing the sample between two glass slides and applying weight.

Formula used:

$$S = \frac{M \times L}{T}$$

Where:

- S = Spreadability
- M = Weight applied
- L = Length moved
- T = Time taken

3.3 Foamability

- A fixed amount of toothpaste was mixed with water.
- The mixture was shaken in a measuring cylinder.
- Foam volume was recorded before and after shaking (Mali & Malik, 2022)[8].

3.4 pH Determination

- 10 g of toothpaste was dissolved in 10 mL distilled water.
- The mixture was stirred thoroughly.
- pH was measured using a digital pH meter (Senthilkumar et al., 2022)[9].

3.5 Abrasiveness

- The toothpaste was rubbed on butter paper.
- Checked for presence of sharp or hard particles.
- Ensures safety for enamel (Rathi & Sirsat, 2022)[10].

3.6 Moisture Content

- Sample was weighed and dried in an oven at 105°C.
- Loss in weight was calculated (Yadav et al., 2021)[11].

Formula: % Moisture = Initial weight

Initial weight – Final weight × 100

RESULT:

The formulated herbal toothpaste exhibited satisfactory results across all evaluation parameters, consistent with previous findings on herbal dentifrices (Divya & Suresh, 2021)[12] (Singh & Kaur, 2023)[6].

The physical examination revealed that the toothpaste had a pleasant color, acceptable taste, and smooth texture, making it suitable for regular use. These observations are comparable to commercially available herbal toothpastes (Palkar et al., 2020)[15]. Figure 04 shows the herbal powders used in the formulation.

**CLOVE & AMLA POWDER****NEEM & CINNAMON POWDER**

Figure 04: Physical examination - Clove & Amla powder, Neem & Cinnamon powder

The spreadability test indicated that the formulation spreads easily, ensuring proper coverage on the tooth surface during brushing, as illustrated in Figure 05. Similar results have been reported by Gangurde et al. (2023)[7] and Mali & Malik (2022)[8].

**CLOVE & AMLA POWDER****NEEM & CINNAMON POWDER**

Figure 05: Spreadability test of the herbal toothpaste formulation

Foamability was observed to be slightly lower compared to synthetic toothpaste due to the reduced concentration of surfactants. However, this does not significantly affect its cleaning efficiency, as herbal ingredients contribute to antimicrobial action (Rathi & Sirsat, 2022)[10].

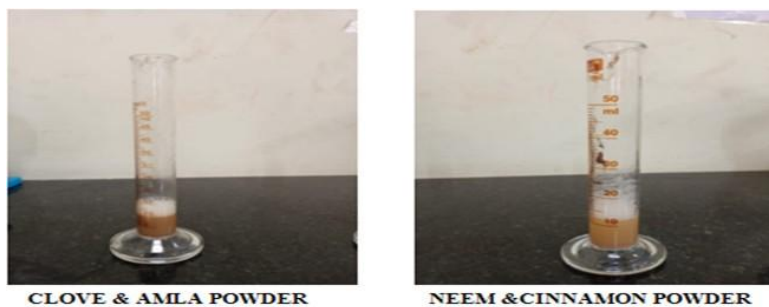


Figure 06: Foaming properties of the herbal toothpaste

The pH of the toothpaste was found to be in the range of 8.03 to 8.07, indicating a slightly alkaline nature. This is beneficial as it helps neutralize acids produced by oral bacteria, thereby preventing enamel demineralization (Devrimci & Sebnem, 2020)[14] (Lippert, 2013)[19]. Figure 07 shows the pH determination process. This pH range is consistent with values reported by Senthilkumar et al. (2022)[9] for herbal toothpaste formulations.

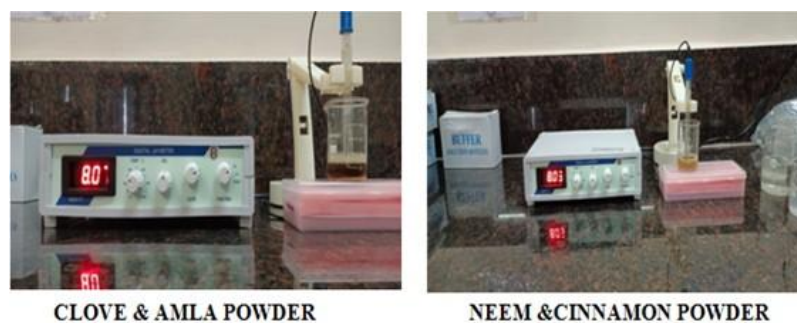


Figure 07: pH determination of the herbal toothpaste formulation

The abrasiveness test confirmed the absence of harsh particles, ensuring that the toothpaste is safe for enamel and does not cause damage to teeth surfaces (Addy & Dowell, 1983)[20]. Moisture content was within acceptable limits, indicating good stability and shelf-life of the product (Yadav et al., 2021)[11].

The presence of neem, clove, cinnamon, and amla enhances the antibacterial and anti-inflammatory properties of the toothpaste (Grover &

Shenoy, 2021)[13] (Mehta & Joshi, 2024)[4]. These herbal ingredients effectively inhibit the growth of oral pathogens such as *Streptococcus mutans* and reduce plaque formation (Kumar & Singh, 2025)[2] (Verma & Gupta, 2024)[3].

Overall, the herbal toothpaste demonstrated comparable effectiveness to commercial toothpaste, with the added advantage of being natural and free from harmful chemicals (Sharma & Patel, 2025)[1] (Reddy & Kumar, 2024)[5]

CONCLUSION:

The present study successfully formulated and evaluated a herbal tooth- paste containing clove, amla, neem, and cinnamon extracts. The formula- tion demonstrated satisfactory physical properties, pH level, and effective antibacterial activity (Mali & Malik, 2022)^[8] (Gangurde et al., 2023)^[7].

The herbal toothpaste proved to be a safe, effective, and economical al- ternative to synthetic toothpaste (Singh & Kaur, 2023)^[6] (Divya & Suresh, 2021)^[12]. It helps in maintaining oral hygiene, preventing dental caries, and reducing microbial load without causing adverse side effects (Panda, 2019)^[16] (Phalke et al., 2019)^[17].

The study highlights the potential of herbal formulations in oral health- care and suggests further research for large-scale production and clinical evaluation (Sharma & Patel, 2025)^[1] (Kumar & Singh, 2025)^[2]

CONFLICT OF INTEREST:

This paper is based on a conceptual review of published literature and does not involve direct funding or collaboration with commercial biotechnology entities. The author declares no financial or personal conflicts of interest related to the subject matter discussed.

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